

WHAT IS CLAIMED IS:

1. A method for hydrotreating a Diesel feedstock, comprising the steps of:
 - providing a feedstock containing a Diesel feed fraction and sulfur;
 - and feeding said feedstock to a hydrotreating reactor containing a catalyst selective toward Cetane Index improving reactions and hydrodesulfurization reactions so as to provide a product stream containing an improved Diesel fraction having an increased Cetane Index as compared to said Diesel Feed fraction, wherein said catalyst is substantially resistant to sulfur deactivation.
2. The method of claim 1, wherein said feeding step comprises feeding said feedstock to a hot separator system to provide a gas phase and a liquid phase, feeding said gas phase to a gas phase reactor containing said catalyst, feeding said liquid phase to a liquid phase reactor containing said catalyst, and combining product from said gas phase reactor and said liquid phase reactor so as to provide said product stream.
3. The method of claim 1, wherein said catalyst has a start of run Cetane Index activity and an end of run Cetane Index activity defined as activity increasing Cetane Index after use of said catalyst in hydrotreating conditions exposed to H₂ S partial pressure of at least about 5 psig and for at least about 180 days, and wherein said end of run Cetane Index activity produces a Cetane number improvement of at least 5.

4. The method of claim 1, wherein said catalyst has a start of run hydrodesulfurization activity and an end of run hydrodesulfurization activity defined as activity in hydrotreating conditions exposed to H₂S partial pressure of at least about 5 psig and NH₃ partial pressure of at least about 0.1 psig for a period of at least 180 days, and wherein said end of run hydrodesulfurization activity is at least about 50% wt.

5. The method of claim 1, wherein said catalyst has a start of run nitrogen removal activity and an end of run nitrogen removal activity defined as activity in hydrotreating conditions exposed to H₂S partial pressure of at least about 5 psig and NH₃ partial pressure of at least about 0.1 psig for a period of at least 180 days, and wherein said end of run nitrogen removal activity is at least 40% wt.

6. The method of claim 1, wherein said catalyst has a start of run aromatic reduction activity and end of run aromatic reduction activity defined as activity in hydrotreating conditions exposed to H₂S partial pressure of at least about 5 psig and NH₃ partial pressure of at least about 0.1 psig for a period of at least 180 days, and wherein said end of run aromatic reduction activity is at least 40% wt.

7. The method of claim 1, wherein said catalyst has a start of run LVGO conversion activity and an end of run LVGO conversion activity defined as activity in hydrotreating conditions exposed to H₂S partial pressure of at least about 5 psig and NH₃ partial pressure of at least about 0.1 psig for a period of at least 180 days, and wherein said end of run LVGO conversion activity is at least 20% wt.

8. The method of claim 1, wherein said catalyst comprises a base selected from the group consisting of alumina, aluminosilicate, aluminotitanate and combinations

thereof, and at least one metal selected from the group consisting of nickel, tungsten, molybdenum, palladium, phosphorous, titanium and mixtures thereof.

9. The method of claim 1, wherein said catalyst has a surface area of between about 100 and about 175 m²/g, a pore volume of between about 0.3 and about 0.6 m³/g and a ratio of mesopore pore volume to total pore volume of between about 0.1 and about 0.3.

10. The method of claim 1, wherein said catalyst has an oxygen adsorption capacity of between about 0.3 and about 0.8 mmol/g at 300°C, an amine absorption capacity at room temperature of between about 0.3 and about 0.5 mmol/g, an amine desorption capacity at 300°C of between about 0.2 and about 0.45 mmol/g, and an amine desorption capacity at 500°C of between about 0.02 and about 0.1 mmol/g.

11. The method of claim 2, wherein said gas phase contains hydrogen, naphtha, Diesel, light vacuum gas oil, C₁-C₄ hydrocarbons, H₂S and NH₃.

12. A sulfur resistant catalyst, comprising a base selected from the group consisting of alumina, aluminosilicate, aluminotitanate and combinations thereof, and at least one metal selected from the group consisting of nickel, tungsten, molybdenum, palladium, phosphorous, titanium and mixtures thereof, wherein said catalyst is substantially resistant to sulfur deactivation.

13. The catalyst of claim 12, wherein said catalyst has a start of run Cetane Index activity and an end of run Cetane Index activity defined as activity increasing Cetane Index after use of said catalyst in hydrotreating conditions exposed to H₂S partial pressure of at least about 5 psig and for at least about 180 days, and wherein said end of run Cetane Index activity produces a Cetane number improvement of at least 5.

14. The catalyst of claim 12, wherein said catalyst has a start of run hydrodesulfurization activity and an end of run hydrodesulfurization activity defined as activity in hydrotreating conditions exposed to H₂S partial pressure of at least about 5 psig and NH₃ partial pressure of at least about 0.1 psig for a period of at least 180 days, and wherein said end of run hydrodesulfurization activity is at least about 50% wt.

15. The catalyst of claim 12, wherein said catalyst has a start of run nitrogen removal activity and an end of run nitrogen removal activity defined as activity in hydrotreating conditions exposed to H₂S partial pressure of at least about 5 psig and NH₃ partial pressure of at least about 0.1 psig for a period of at least 180 days, and wherein said end of run nitrogen removal activity is at least 40% wt.

16. The catalyst of claim 12, wherein said catalyst has a start of run aromatic reduction activity and end of run aromatic reduction activity defined as activity in hydrotreating conditions exposed to H₂S partial pressure of at least about 5 psig and NH₃ partial pressure of at least about 0.1 psig for a period of at least 180 days, and wherein said end of run aromatic reduction activity is at least 40% wt.

17. The catalyst of claim 12, wherein said catalyst has a start of run LVGO conversion activity and an end of run LVGO conversion activity defined as activity in hydrotreating conditions exposed to H₂S partial pressure of at least about 5 psig and NH₃ partial pressure of at least about 0.1 psig for a period of at least 180 days, and wherein said end of run LVGO conversion activity is at least 20% wt.

18. The catalyst of claim 12, wherein said catalyst has a surface area of between about 100 and about 175 m^2/g , a pure volume of between about 0.3 and about 0.6 m^3/g and a ratio of mesopore pure volume to total pure volume of between about 0.1 and about 0.3.

19. The catalyst of claim 12, wherein said catalyst has an oxygen adsorption capacity of between about 0.3 and about 0.8 mmol/g at 300°C, an amine absorption capacity at room temperature of between about 0.3 and about 0.5 mmol/g, an amine desorption capacity at 300°C of between about 0.2 and about 0.45 mmol/g, and an amine desorption capacity at 500°C of between about 0.02 and about 0.1 mmol/g.